Support Concept for the Creation and Use of Doctrines – How to Present Planning Items in a Combat Direction System

Annette Kaster
Research Institute for Communication
Information Processing and Ergonomics
Neuenahrer Strasse 20
53343 Wachtberg-Werthhoven
GERMANY
Tel.: +49 228 9435492

a.kaster@fgan.de

Marine operators need modern command, control and weapon systems in order to fulfil their tasks in identification, classification and combat. Configuration adjustments at the technical board systems as well as at the control software have to be performed continuously dependent on the actual operational and tactical situation. These system adaptations depend on variations of parameter adjustments and can be optimised using computer supported configuration aids.

Doctrines allow the early time and situation dependent automated configuration of ships in order to function optimally in time critical situations. The aim is the optimised adjustment of corresponding algorithms and systems. This requires an as complete as possible planning.

Doctrines are special decision rules that describe the dependencies of required actions on occurring events. They refer to task sequences that define the timely configuration of weapon systems and the required parameter adjustments when situation data change that relate to the tactical and technical mission environment. Working with doctrines implies characteristically the handling of a variety and multitude of parameters and situation data and the definition and implementation of their dependencies.

Given this variety a doctrine control without potential interaction of the operator is not conceivable. The operator should be informed about the actual parameter adjustments, the system state, the state of the doctrine control and the chances to intervene manually if required. This can only be ensured, if the support system (in form of a doctrine control) has a task- and user-oriented as well as an ergonomically designed human-machine interface.

In creation of doctrines the main problem is the immense number of parameters to be taken into account as well as adjusted. Regarding that difficulty a support concept has been developed with the main focus on a user deserved conception in consideration of economic, navy-specific requirements. Although dealing here with a naval application the concept can easily be conferred to any other domain like other military forces or even civilian applications.

The generic ergonomic support concept describes the support requirements for the different users of the complete planning process. It starts with the creation of basic building blocks (components like situation data, system states, parameter adjustments, actions, etc.), continues with the creation and evaluation of mission specific planning items and ends with the use onboard (or “in the field” considering a different application domain). The tasks in creation and use of doctrines are conceptually comparable for the *basic data manager*, the *mission planer* and the *navy operator* onboard but differ in their objective targets.

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One part of this generic concept has been realised prototypically, i.e. the support of the mission planer in creating and using doctrines. For the creation a doctrine editor with doctrine database has been developed. For the use, i.e. evaluation of the "mission database" by the mission planer, an interactive simulation component has been created and implemented. In order to demonstrate the feasibility a prototype has been developed with the following components (picture 1):

1) the *doctrine database* with the *doctrine editor* as user interface
2) the *situation database* for inputting, managing and processing scenario, own ship and mission data with a visualisation component for the situation data
3) a central *simulation component* with inference engine, database and time management
4) an *output component* for presenting system parameters and "operator notifications"

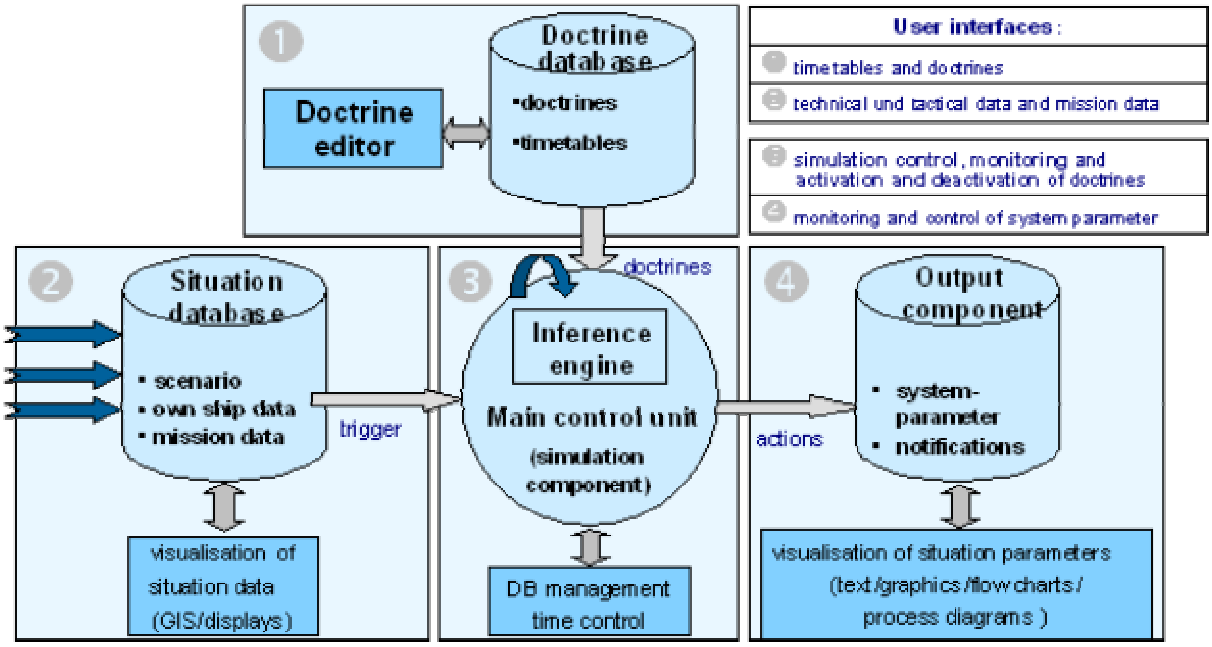


Figure 1: Architecture of the Prototype.

The prototype provides in its functionality the doctrine creation as well as dynamic simulations. This allows the test of the interrelations of doctrine creation and use and the optimisation of the "mission database" by evaluation before it is used as a "Ready4ActionDatabase" onboard. In order to present the feasibility the simulation runs with the "mission database", the system data, a representative scenario and situation data as events.

A scenario describing a two-day mission/exercise has been defined in cooperation with navy personnel. It was used to demonstrate the support of the mission planer in creating a mission database using the ergonomical designed doctrine editor. The layout/structure of the database reflects the actual planning state at any time. The simulation environment represents the mission process, the state of the doctrine control as well as the intervention possibilities.

Future work will deal with the complete planning process. In the area of the mission planning solutions have to be found for the evaluation of the "mission database" in manual or automated form. Prerequisites are the determination of evaluation criteria for the quality of the "mission database" (by the Navy). Typical scenarios and missions have to be identified and formulated for verification of the doctrines.

From the ergonomic point of view the visualisation of the numerous planning items, like “Operational Parameter”, “Situation Data”, “System Data” as well as doctrines, time tables etc., is an important, user friendly aspect that refers to the complete handling with doctrines. A visualisation concept dependent on the requirements for the system users has to be developed.

Problems arise while facing the variety and the magnitude of data involved in the planning and execution of (naval) missions. A user interface for system conditioning has to be developed that allows the operator to visualize the system state in regard to the qualitative effect of parameter values (reading access). Optimised tools should enable a safe and situation related direct control of parameter adjustments (writing access).

The following aspects related to visualisation have to be considered:

- Representation of adjustments of operational parameters; development of “orientation guides” and procedures that consider the diversity of parameter values and their logical groupings.
- Representation procedures for clarifying the coaction of various parameters (e.g. parameters in “function chains”, mission- and user-conditional dependencies).
- Representation of the actual system state and an anticipated system state (projection) after parameter changes.
- Change of single parameter values either manually on the basis of the presented system state or automatically by the use of doctrines. Representation of critical effects in the overall context of parameter settings.
- Representation of conflict cases, e.g. detection of doctrines that are inconsistent with manually modified parameter values or that are inconsistent with automatically crated doctrines.

This presentation will demonstrate how Navy officers/operators may be supported in the creation, handling and use of doctrines in a Combat Direction System. Ergonomically designed user interfaces for a doctrine editor as well as a doctrine database will be shown. A possible interface for the use of doctrines for testing and evaluating a mission database is demonstrated. Presentation issues for the various numerous planning items and system variables as well as their coactions that are important for visualisation by the user in order to fulfil his task/mission will be subject for discussion.

Support concept for creation and use of doctrines

How to Present Planning Items in a Combat Direction System

Annette Kaster, FGAN-FKIE, Werthhoven, Germany

IST-036/RWS-005 Halden, Norway

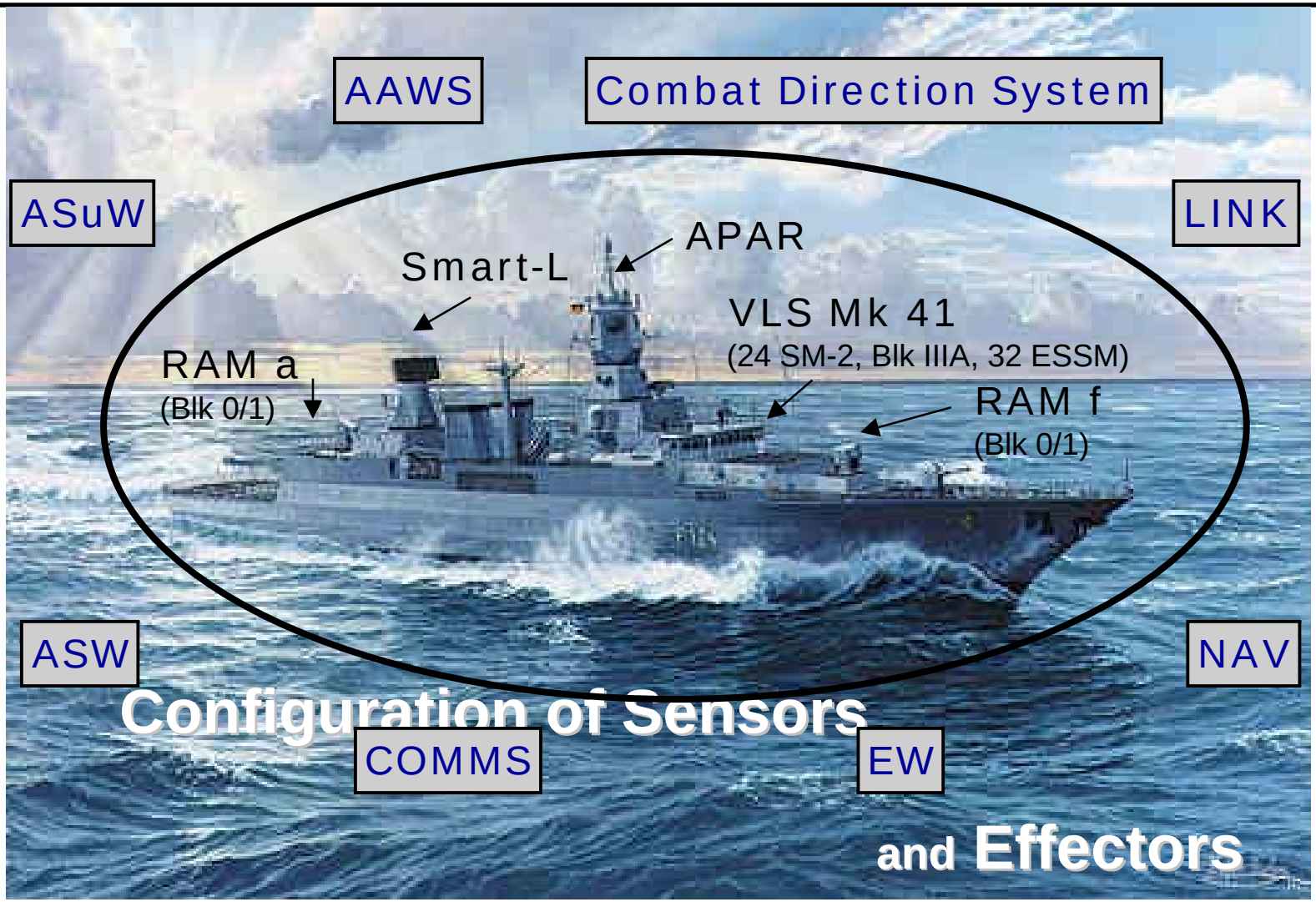
Content

Ergonomic support concept for creation and use of marine doctrines

Prototype demonstration

Representation and visualisation issues

target system: F124 Combat System (CS)



Doctrines ...

... configure the system behaviour

... allow depending on situation data (tactical, technical, environmental)

- a timely confirmation of weapon systems
- a definition of essential parameter adjustments

=>considerable influence on system behaviour

... support the user in time-critical situations

... considerate mission situations (threat, geography, etc.)

... control a multitude of parameters (situation data ~ 27.000, operational parameters ~ 760)

situation dependent events „trigger“ doctrines

time dependent events „trigger“ „TimeTables“

Doctrines

- **structure**:

  Trigger -> Condition --> Action

  ON .. -> IF ... --> THEN

  Trigger/Condition: time, OperatorAction, any kind of events

  Action: modification of values of operational parameters, Operator Notification, Activation (De-) of doctrines

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- **Example Doctrine: Air_Threat_Warning_Red**
  - on **ATW Shift**
  - If **ATW = RED**
  - then **Effector Params = ready**
  - *ON* **= "Check Chaff Course; Comms to plain, weapons to state ready "**

process:
doctrine creation/ administration/ use

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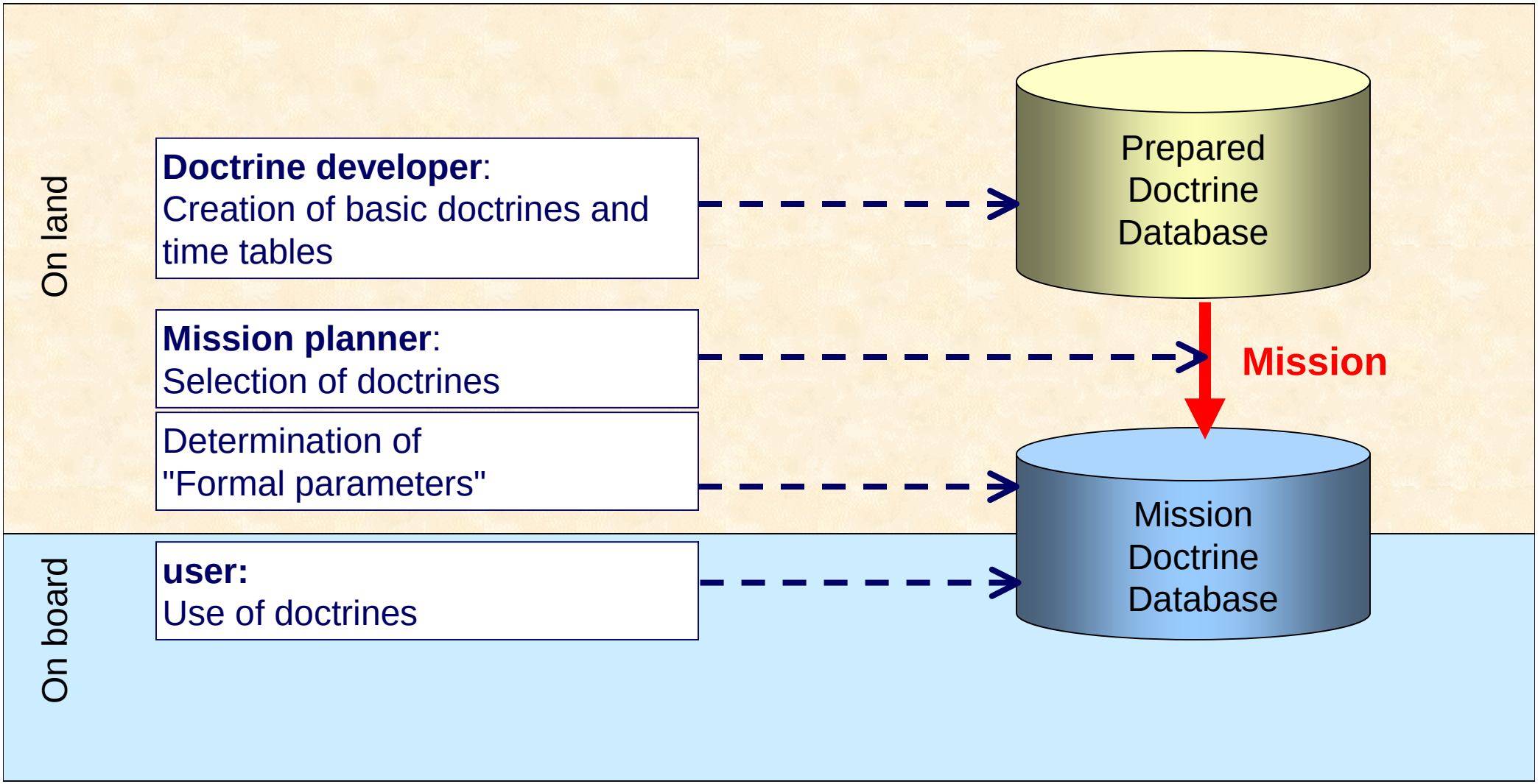

"UkENDo"-Demonstrator (architecture)

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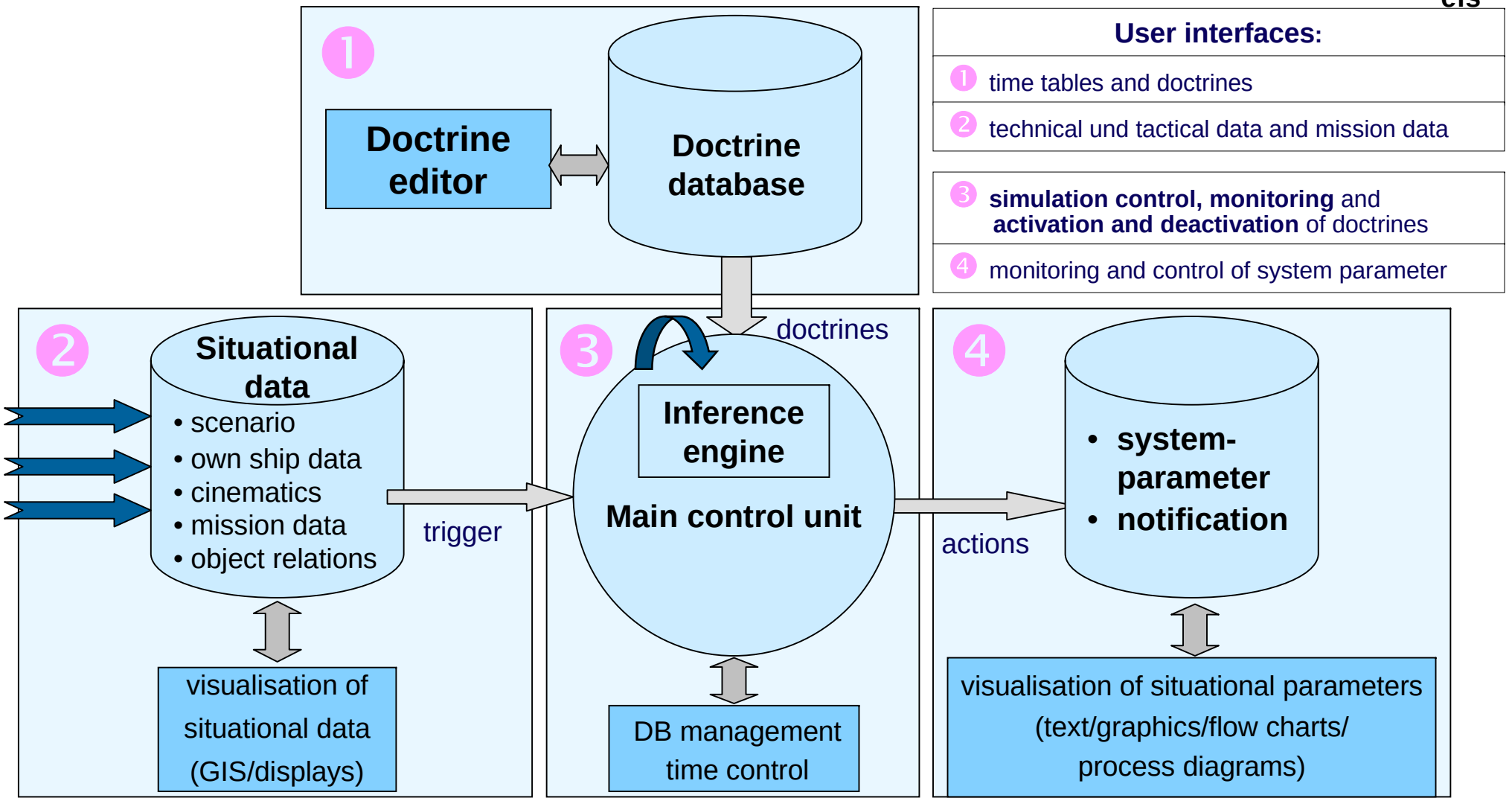

Scenario

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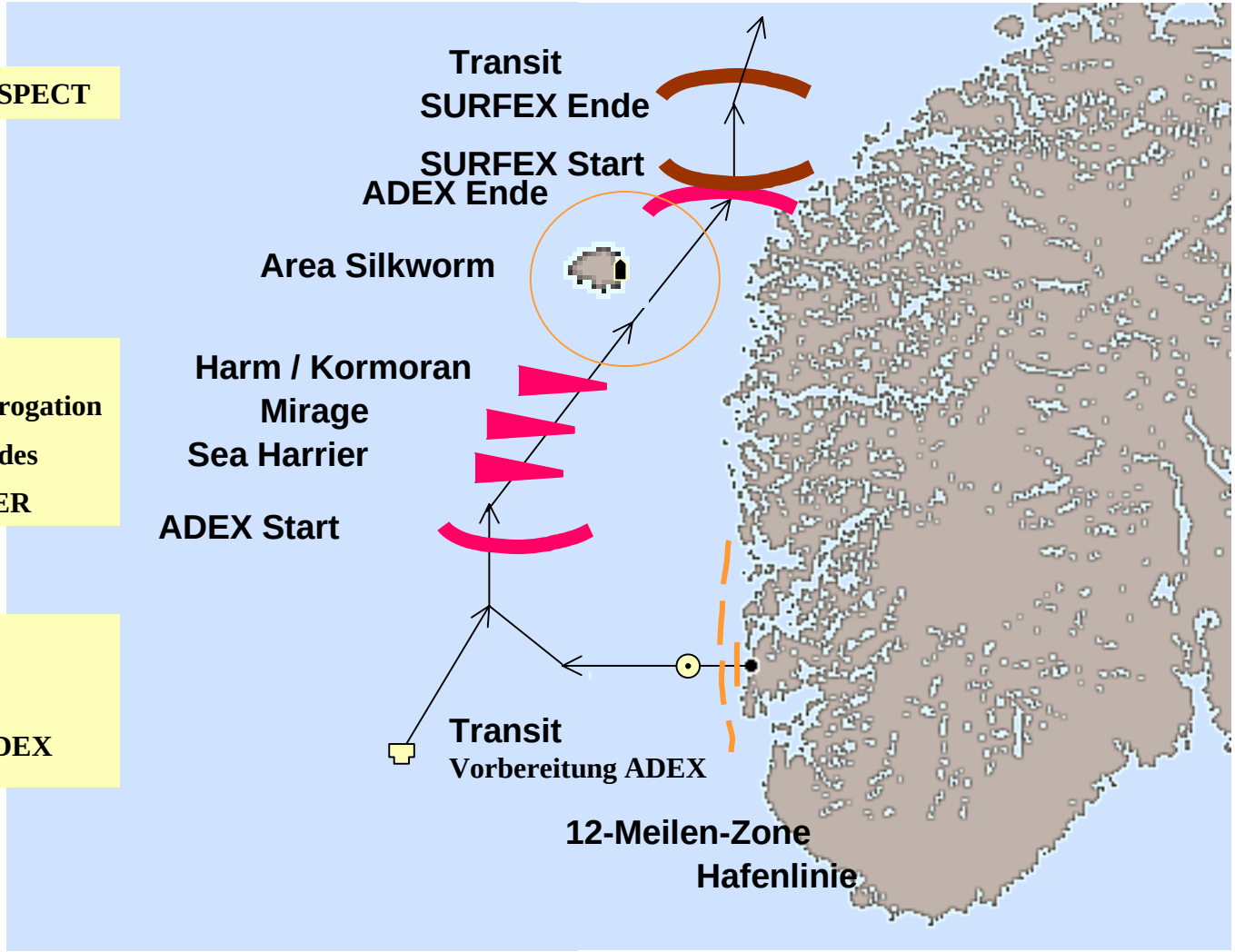
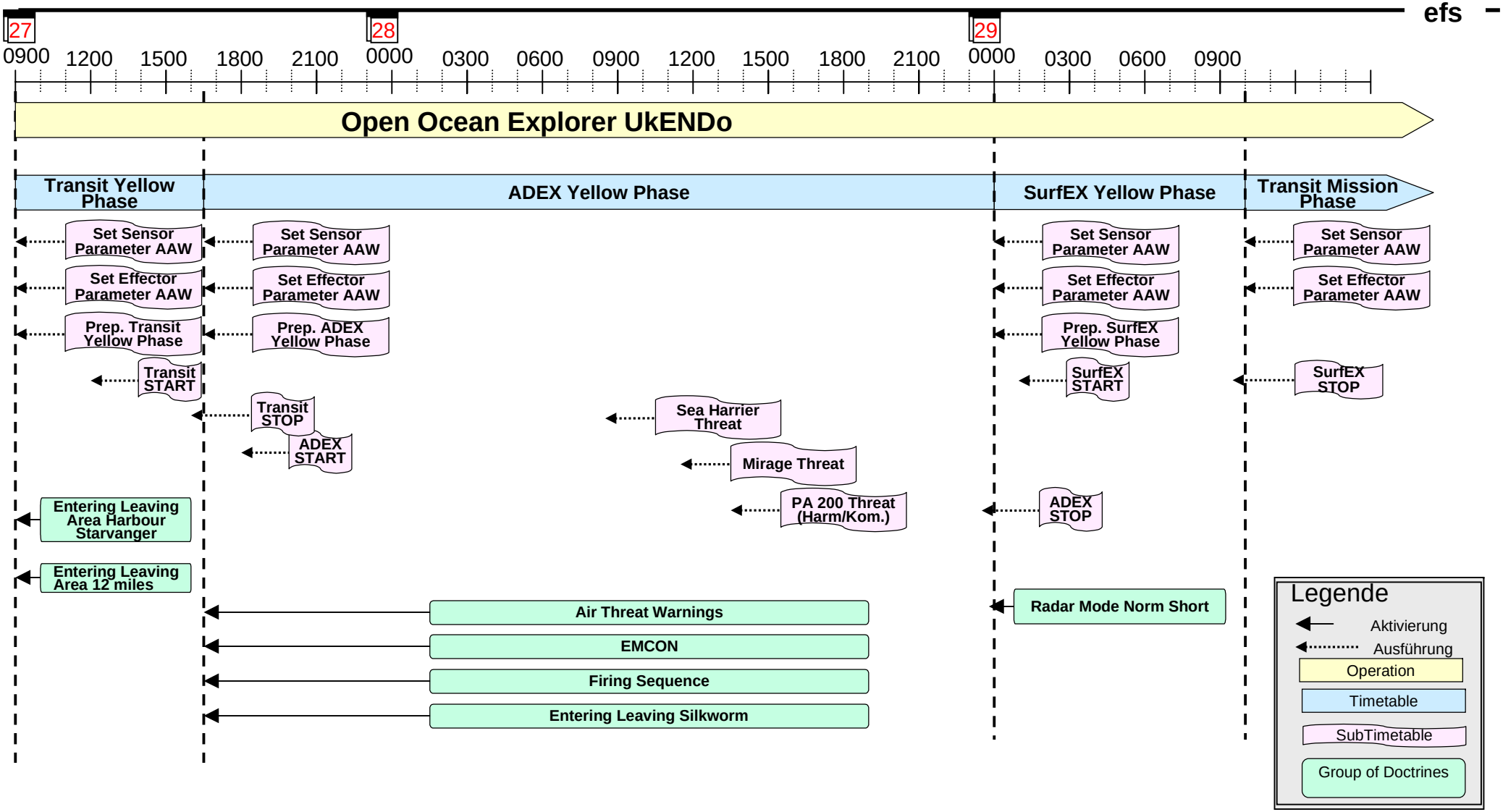
>> HOSTILE / SUSPECT

EMCON Plan
automatic-iff-interrogation
IFF wartime ID codes
>> FAKER / JOKER

Radarsteuerung
Hafengrenze
12-Meilen-Zone
Vorbereitung ADEX



Scenario - Time Frame



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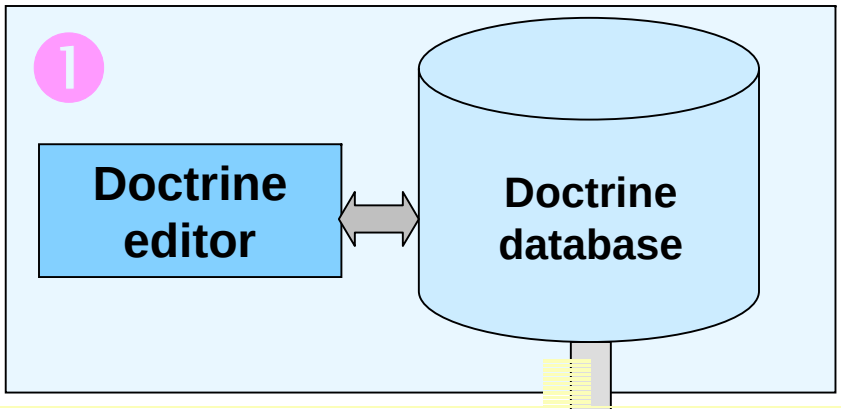
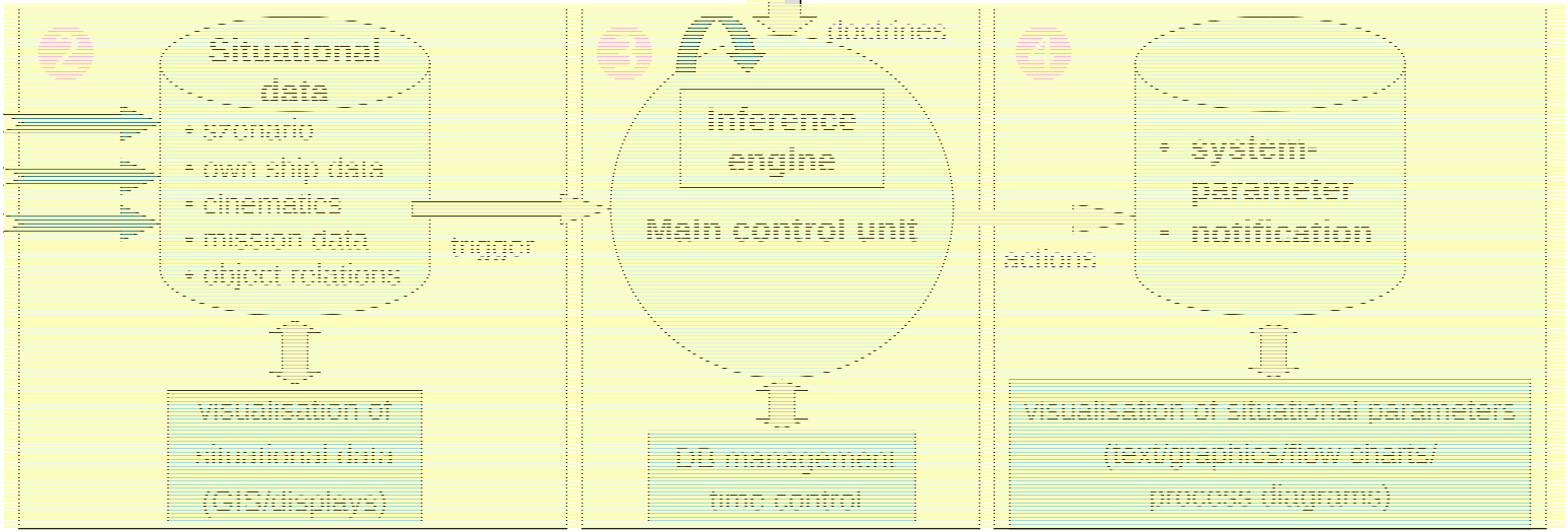


User interfaces:

1. time tables and doctrines
2. technical und tactical data and mission data
3. **simulation control, monitoring** and **activation and deactivation** of doctrines
4. monitoring and control of system parameter



Doctrine editor: ergonomical aspects

- Uniformed structure of all forms for definition of doctrines/TT
- user guided dialog
- task oriented handling
- reuse of components
- definition of rules components in the language of the user
- recurring elements for ergonomic consistency
- selective lists for consistent input
- reuse of rules
- user support by presettings (defaults, range of values, ...)
- graphical displays for formatted inputs
- explanation component
- modification of rules all the time
- automatic set-up of the rule base

Doctrine database: ergonomical aspects

- Overview of the actual planning state
- different views for doctrines
- hierarchical representation of doctrines
  - TimeTable -> SubTimeTable -> Timed Action
  - Doctrine-group -> doctrine -> Immediate Action
- Fading in and out of hierarchical levels
- user guided dialog
- Context related representation
- Effective recherches

Doctrine editor: setup / structure / functionality

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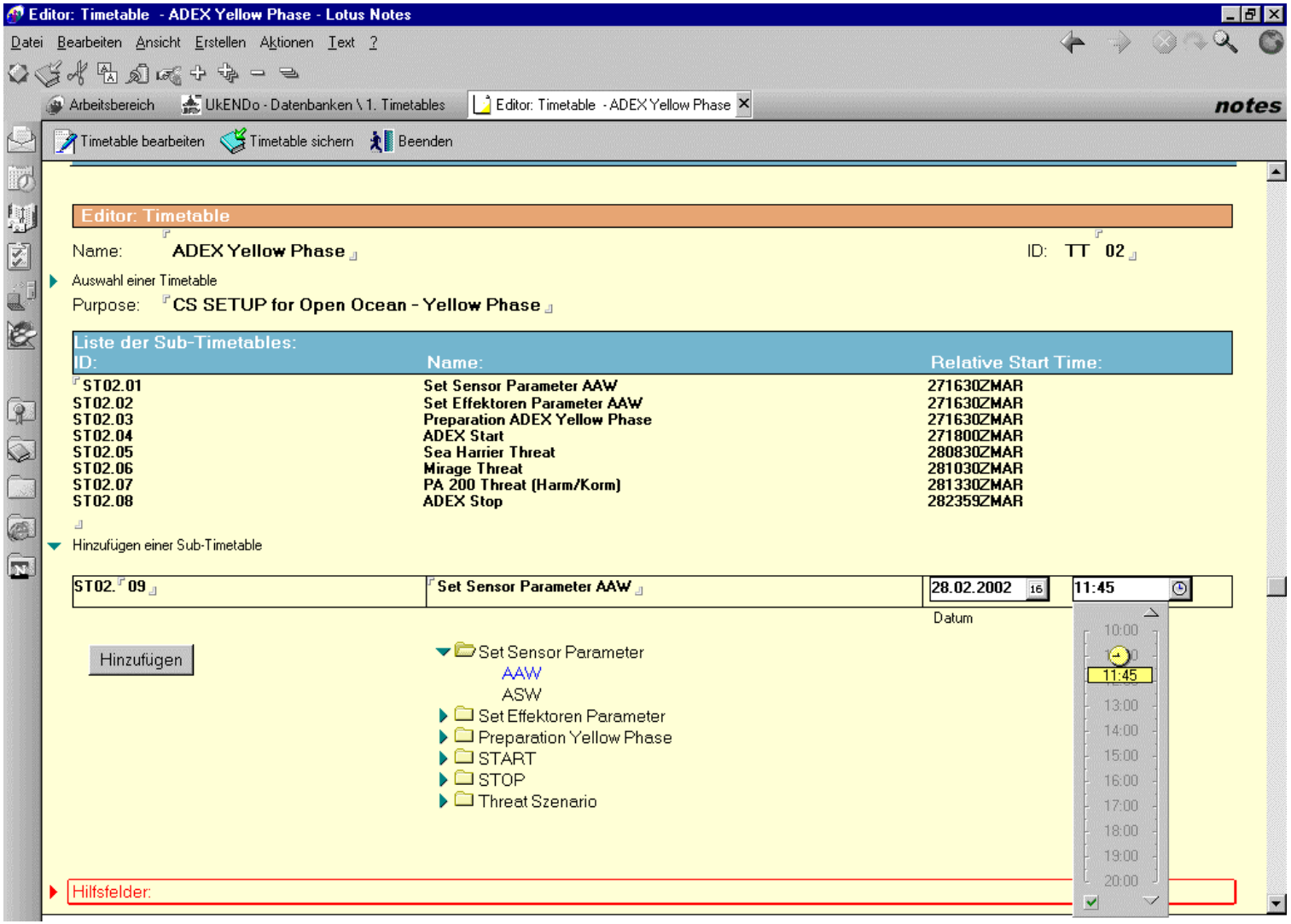

Doctrine database: setup / structure / functionality

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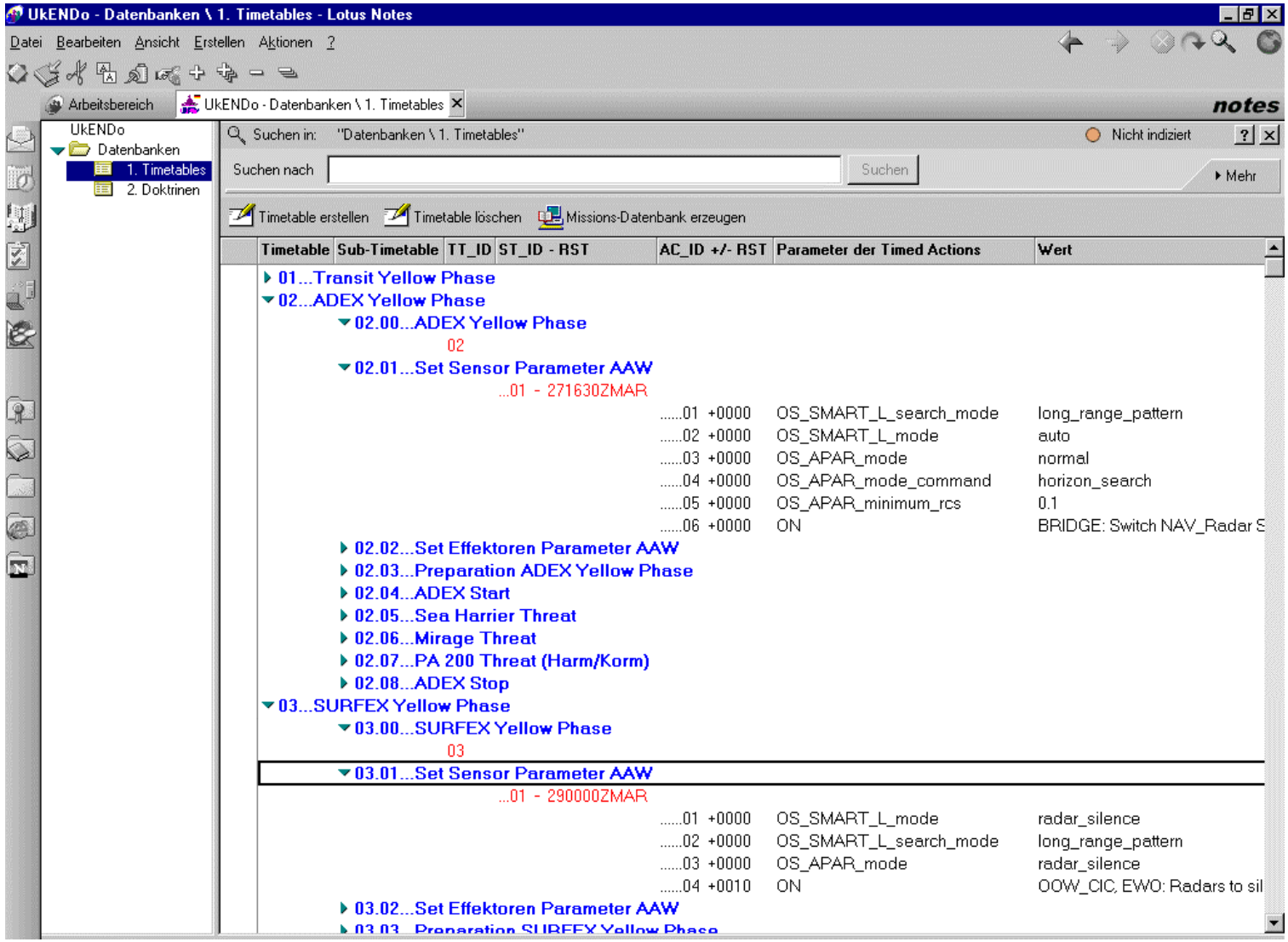

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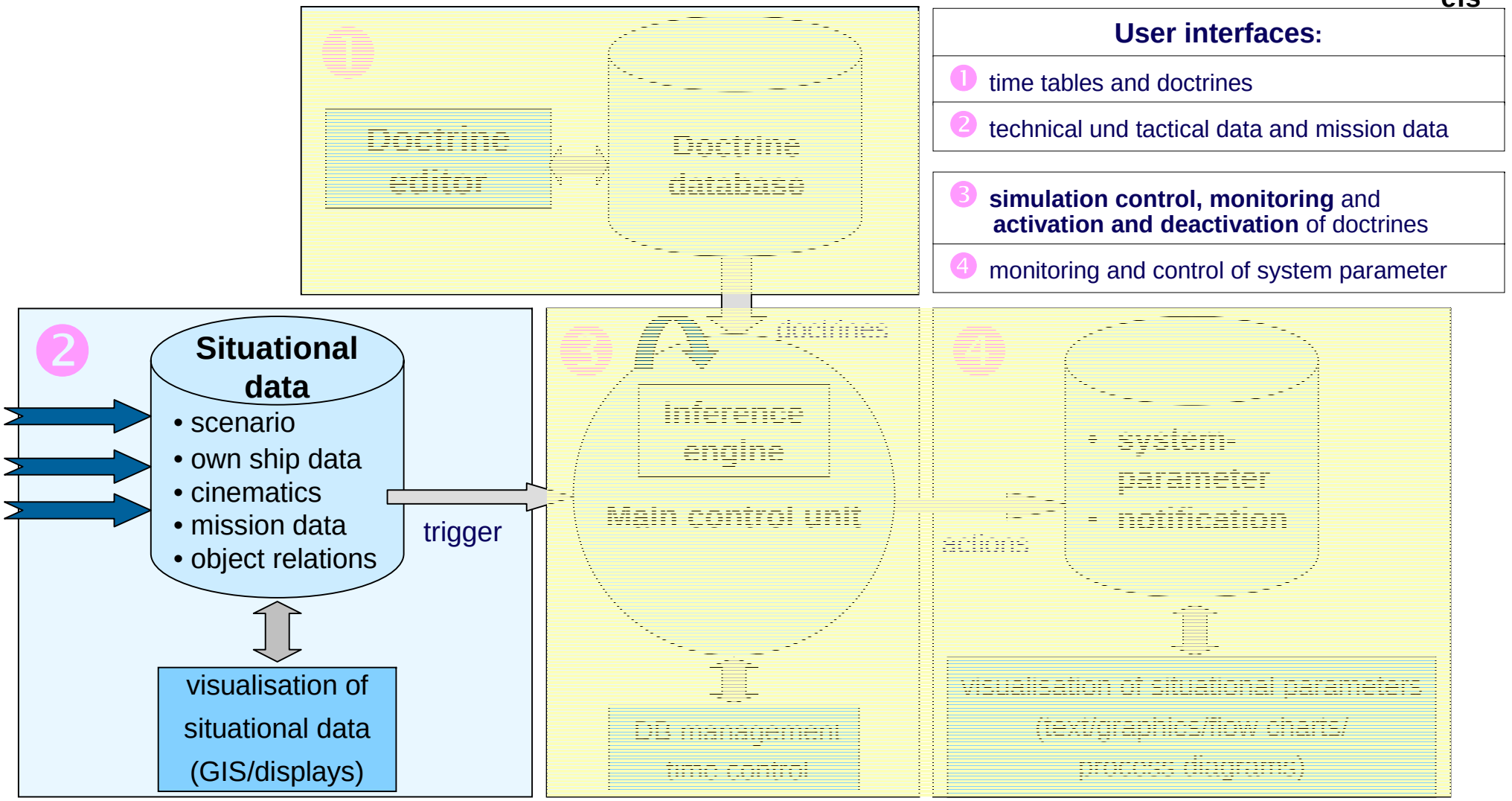

User interfaces:

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Situation database: user interface

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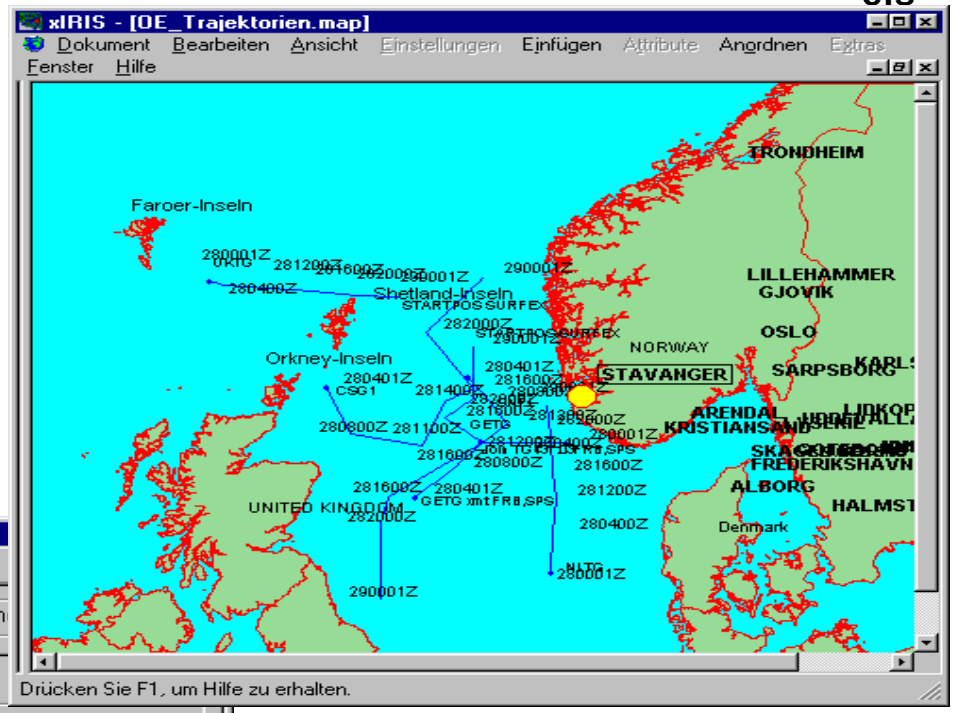

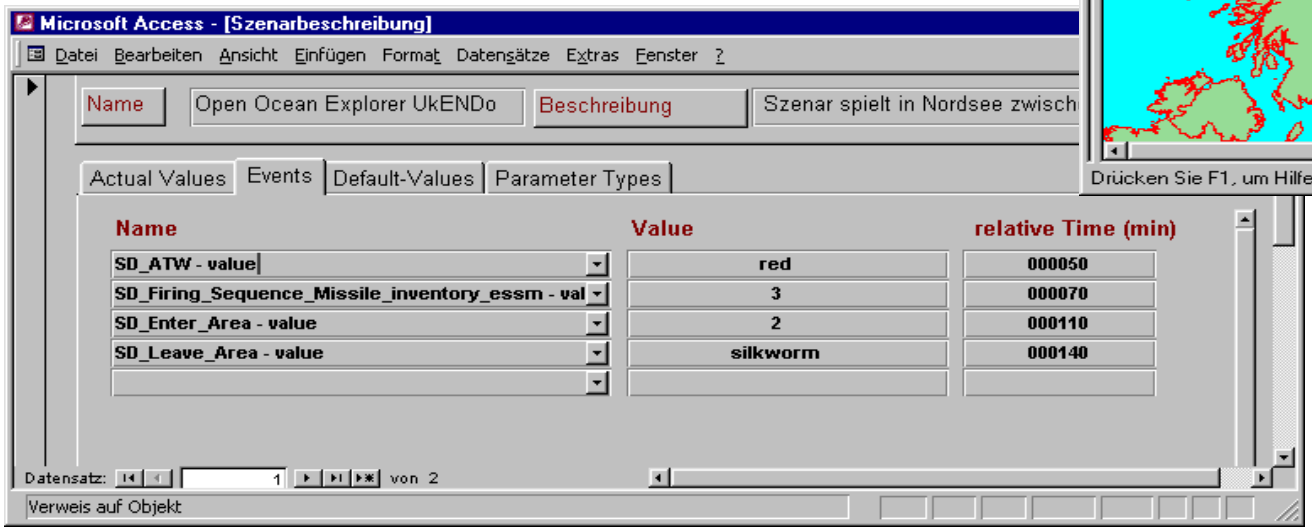

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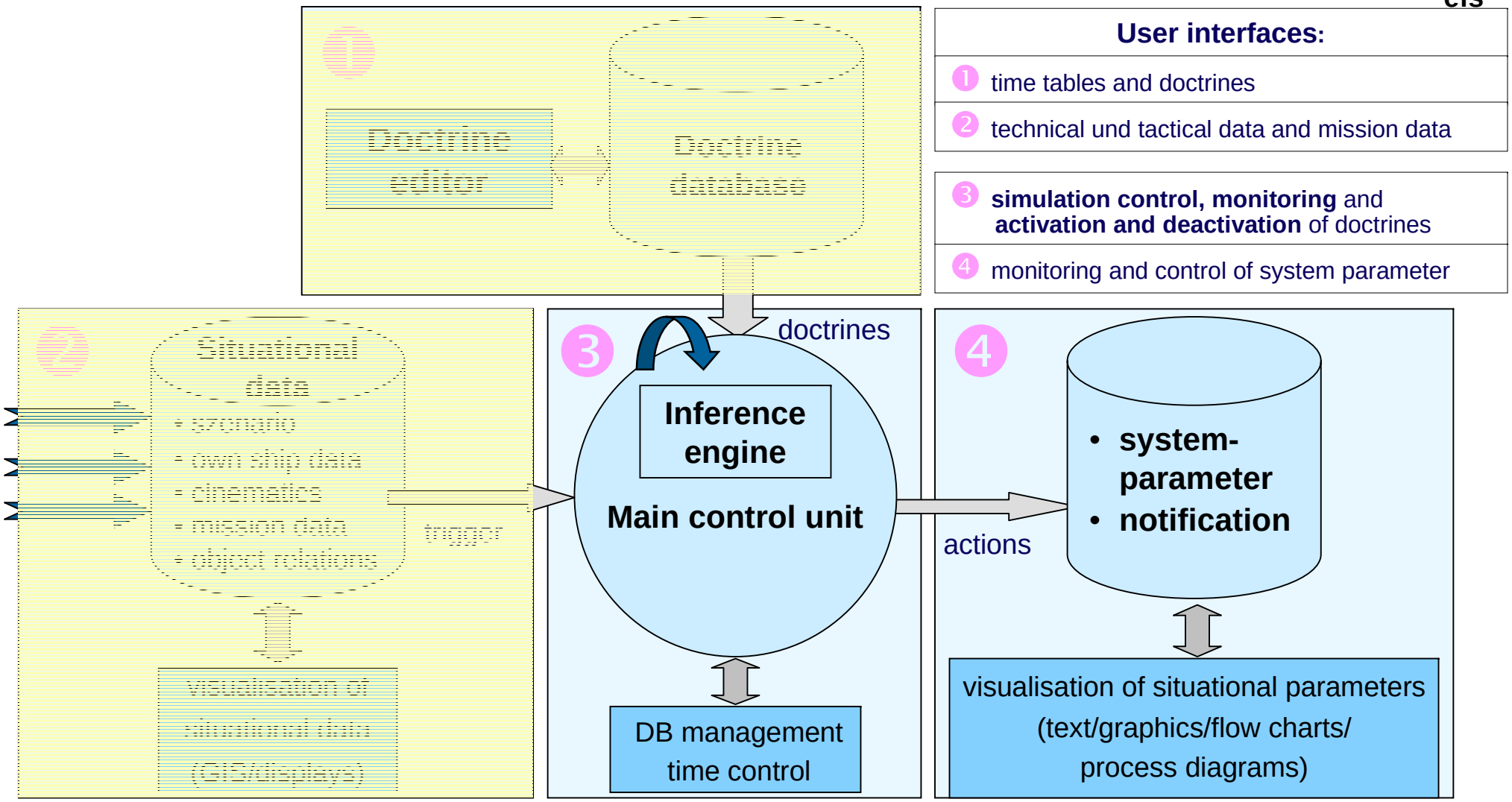

User interfaces:

1. time tables and doctrines
2. technical und tactical data and mission data
3. **simulation control, monitoring** and **activation and deactivation** of doctrines
4. monitoring and control of system parameter

demonstrator: main control unit

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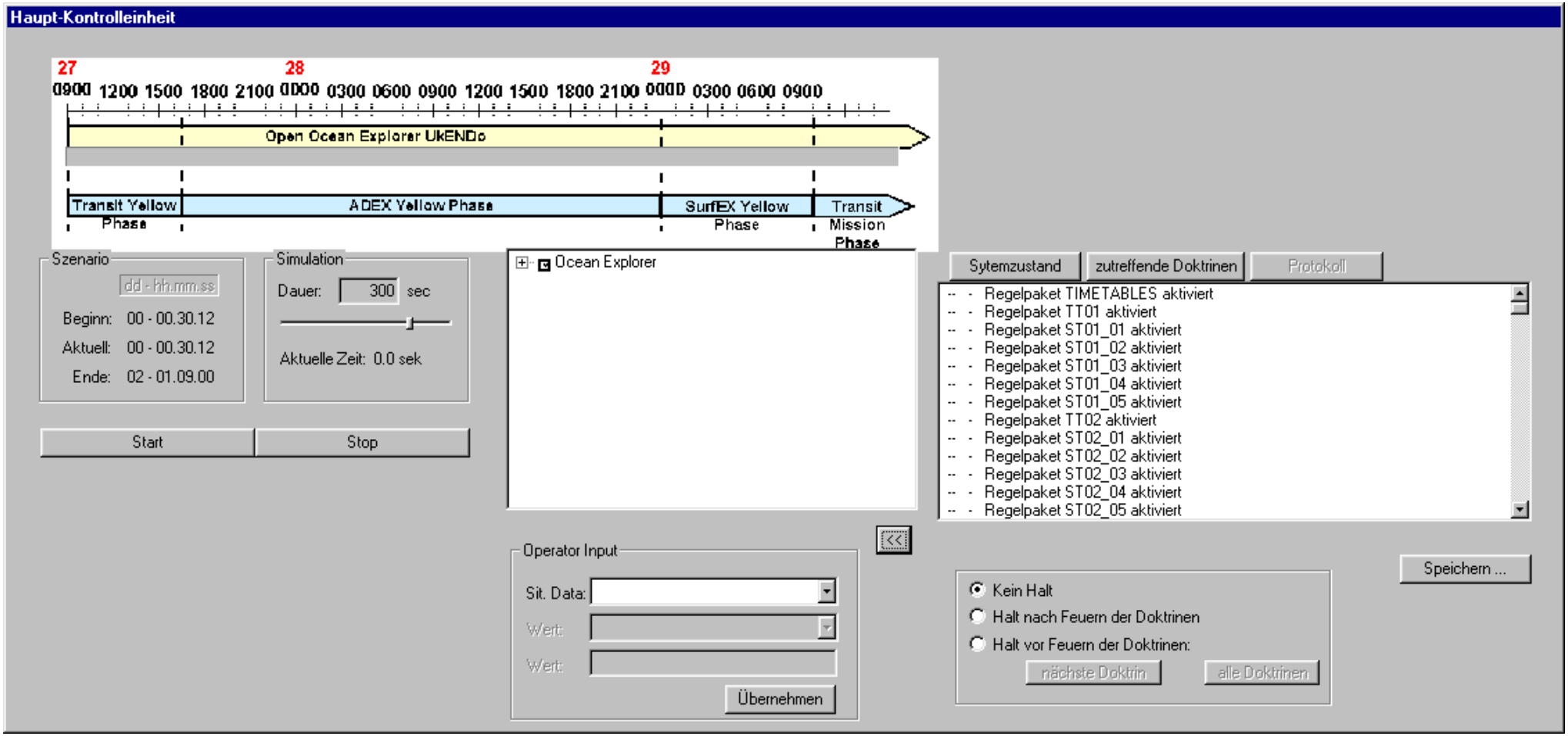
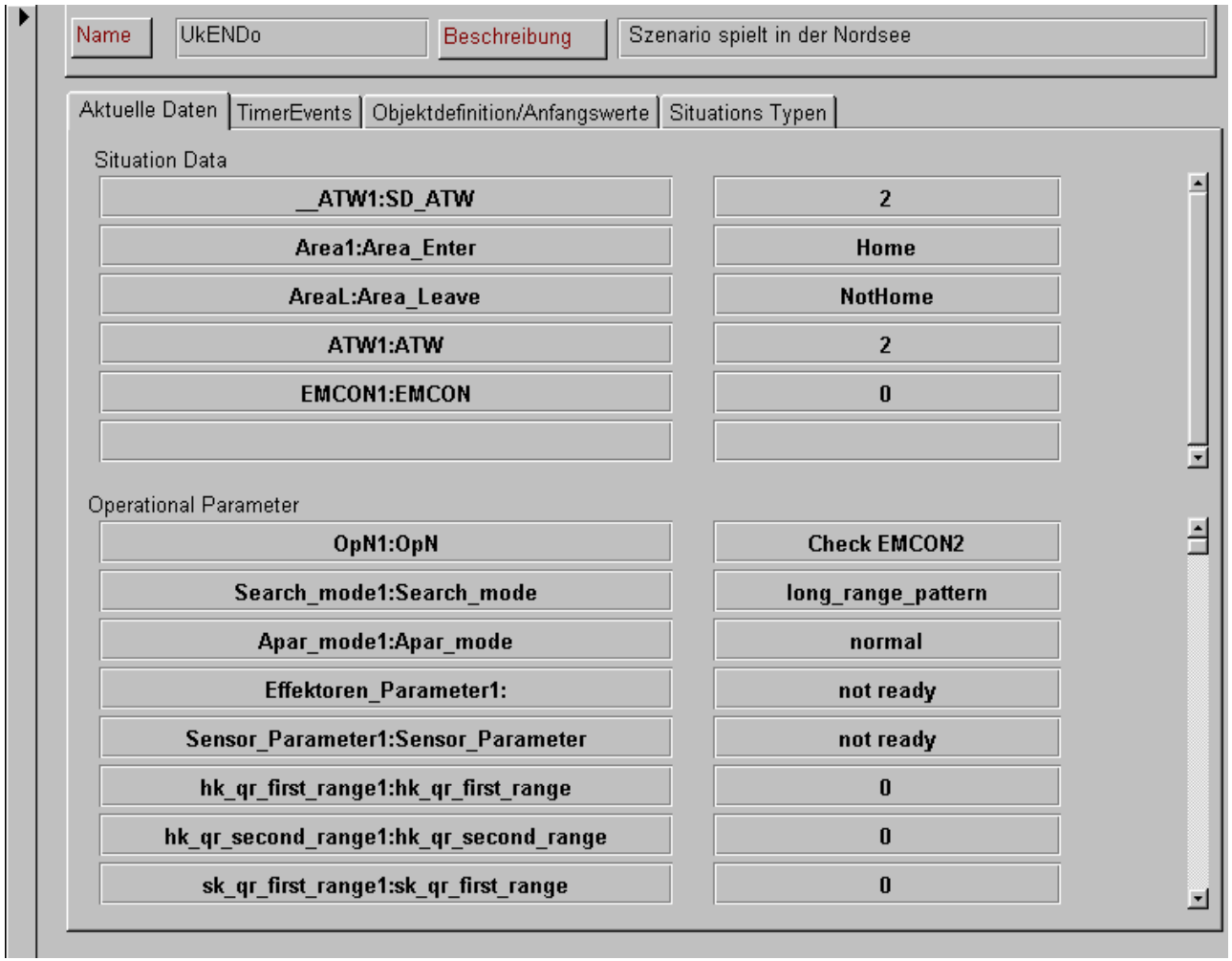


Demonstrator: output component



Representation and Visualisation issues
Consequences, Problems and Further Research

The variety and magnitude of data and the unpredictability of mission requirements demand support in controlling, interpreting and visualising the system state as well as the parameter adjustments.

- **Manual intervention has to be enabled**
- **Complete automation is not conceivable due to the complexity of mission situations.**

Current constraints:

- **automation opposed to user-orientation**
- **UI development in several components by various companies**
- **restricted tools for the design of the UI especially for graphics**

Issues to be addressed:

- **Visualisation of the system state with regard to the qualitative effect of parameter values (reading access).**
- **Optimised tools for safe and situation related direct control of parameter adjustments (writing access).**

Representation and Visualisation issues
Aspects to be Considered

- Representation of operational parameters' adjustments;
  development of "orientation guides" and procedures considering the diversity of parameter values and their logical groupings

- Representation procedures for clarifying the coaction of various parameters (e.g. parameters in "function chains", mission- and user-conditional dependencies)

- Representation of the actual system state and an anticipated system state (projection) after parameter changes

- Change of single parameter values either manually on the basis of the presented system state or automatically by the use of doctrines.
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